

WHAT IS CLAIMED IS:

1. A system for testing gas reactors, comprising:
  - a test gas generator that provides at least one test gas into a primary flow line;
  - 5 a first furnace along the primary flow line, operable to heat the test gas;
  - a first reactor location, switchable in and out of the primary gas line;
  - 10 an upstream branch valve, operable to route the primary flow line to either a first branch line or a second branch line;
  - a second furnace on the first branch line;
  - 15 a second reactor location positioned to receive thermal output directly from the second furnace;
  - a third furnace on the second branch line;
  - a downstream branch valve joining the first branch line and the second branch line;
  - 20 a third reactor location downstream of the downstream branch valve; and
  - an injector subsystem operable to inject a gas or liquid into the first branch line upstream the second reactor location.
2. The system of Claim 1, further comprising a bypass line switchable to bypass the gas mixture from a point upstream of the first reactor location to a point downstream of the third reactor location.
3. The system of Claim 1, further comprising a humidifier operable to mix water vapor into the test gas.

4. The system of Claim 3, wherein the humidifier is located upstream the first furnace.

5. The system of Claim 1, further comprising a  
5 mixer for mixing the components of the test gas.

6. The system of Claim 5, wherein the mixer is located immediately upstream one of the reactor locations.

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7. The system of Claim 5, wherein the mixer is located immediately upstream the second reactor location.

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8. The system of Claim 5, wherein the mixer is a static mixer.

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9. The system of Claim 1, wherein at least one of the reactor locations comprises an input port, output port, and attachment fittings operable for installing a gas reactor.

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10. The system of Claim 1, further comprising sampling lines for collecting gas samples from the flow line upstream and downstream at least one of the reactor locations.

11. A method of testing gas reactors, comprising the steps of:

providing at least one test gas into a primary flow line;

5 routing the test gas through a first furnace;

switchably connecting a first reactor to the primary flow line downstream the first furnace, such that the first reactor is switchable in and out of the primary gas line;

10 routing the gas flow from the first reactor to an upstream branch valve, operable to route the primary flow line to either a first branch line or a second branch line;

15 wherein the first branch line flows through a second furnace having a second reactor location positioned to receive thermal output directly from the second furnace;

setting the upstream branch valve to select the first branch line;

20 injecting a gas or liquid into the first branch line upstream the second reactor; and

routing the test gas through a downstream branch valve joining the first branch line and the second branch line.

25 12. The method of Claim 11, further comprising the step of connecting a third reactor downstream of the downstream branch valve.

13. The method of Claim 11, further comprising the step of mixing the gas immediately downstream the flow line after the injecting step and upstream the second reactor.

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14. The method of Claim 11, further comprising the step of humidifying the gas mixture upstream the first furnace.

10 15. The method of Claim 11, wherein the method is used to test at least one gas phase reaction.

16. The method of Claim 11, wherein the method is used to test at least one gas-solid reaction.

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17. The method of Claim 16, wherein at least one of the reactors is a catalytic reactor.

18. The method of Claim 16, wherein at least one of  
20 the reactors is a solid reactor.

19. A method of testing engine exhaust emissions, comprising the steps of:

providing at least one test gas into a primary flow line;

5 routing the test gas through a first furnace;

switchably connecting a non thermal plasma reactor to the primary flow line downstream the first furnace, such that the non thermal plasma reactor is switchable in and out of the primary gas line;

10 routing the gas flow from the non thermal plasma reactor to an upstream branch valve, operable to route the primary flow line to either a first branch line or a second branch line;

15 wherein the first branch line flows through a second furnace having a second reactor positioned to receive thermal output directly from the second furnace;

setting the upstream branch valve to select the first branch line;

20 injecting a gas or liquid into the first branch line upstream the second reactor; and

routing the test gas through a downstream branch valve joining the first branch line and the second branch line.

25 20. The method of Claim 19, further comprising the step of connecting a third reactor downstream of the downstream branch valve.

30 21. The method of Claim 19, further comprising the step of humidifying the gas mixture upstream the first furnace.

22. The method of Claim 19, wherein at least one of the second or third reactors is a catalytic reactor.